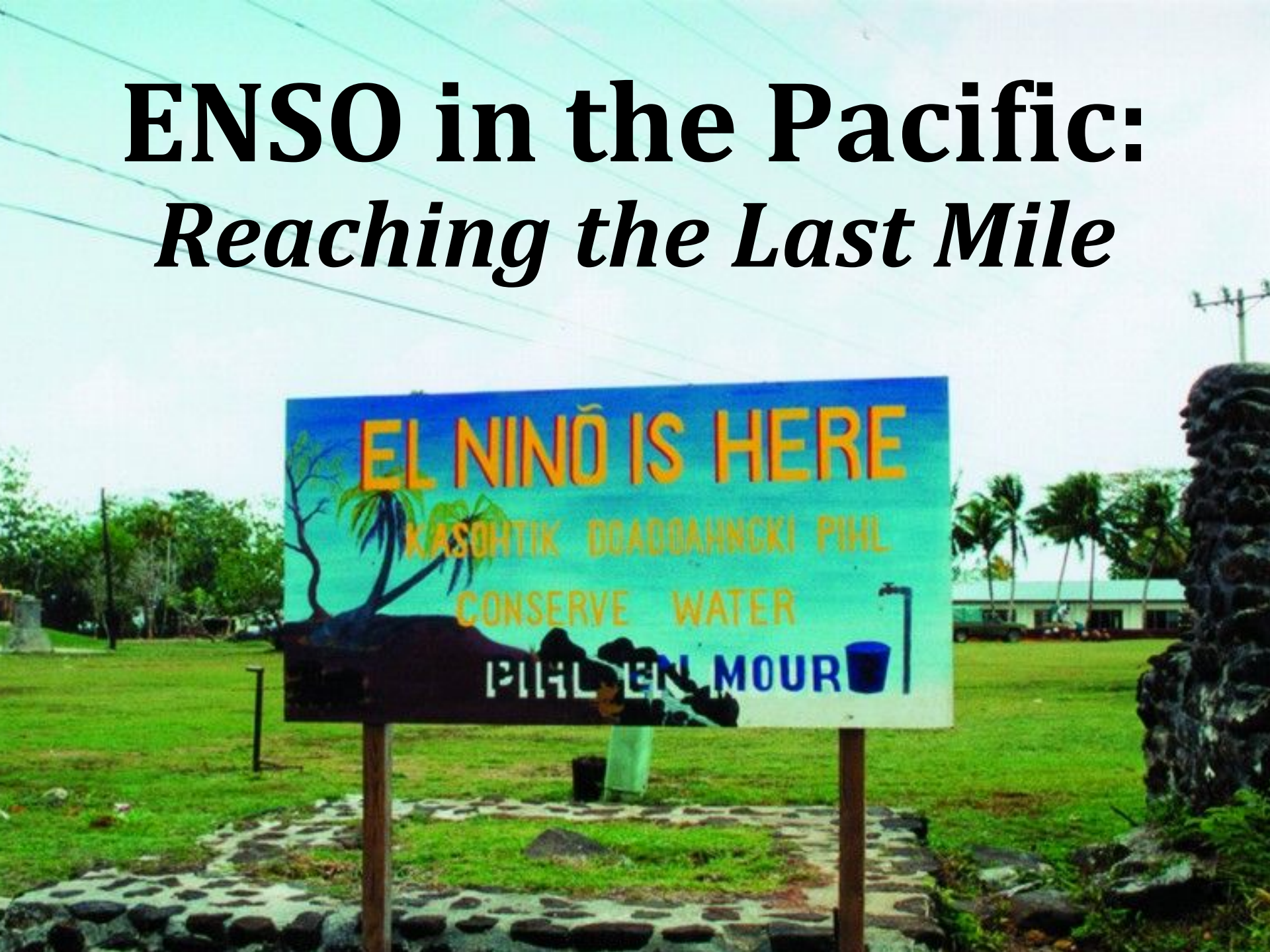
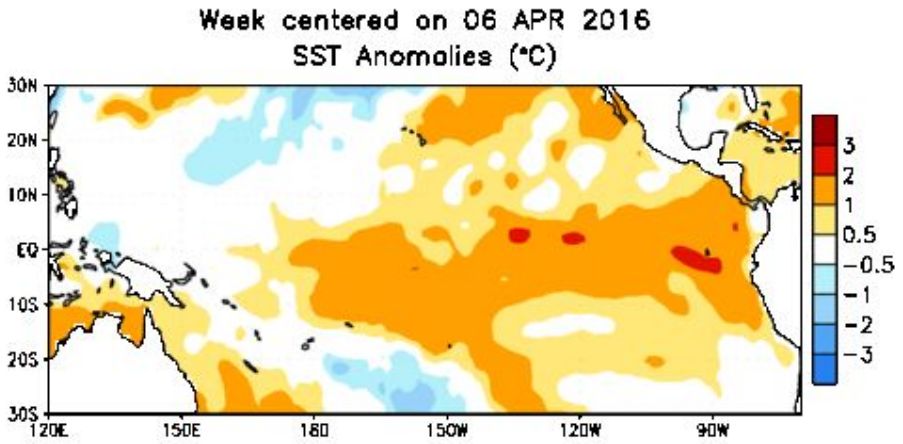
ENSO in the Pacific:
Reaching the Last Mile



El Niño has Significant Impacts for Pacific Islands

- Extreme eastward shift in tropical cyclone genesis and development across Micronesia
- Increase in tropical cyclone activity around Hawaii
- Increased threat of tropical cyclone activity near American Samoa
- Severe drought and increased threat of wildfires
- Large surf causes saltwater intrusion along the coast leading to crop losses
- Please see poster from WFO Guam

Not even a speck on the map…



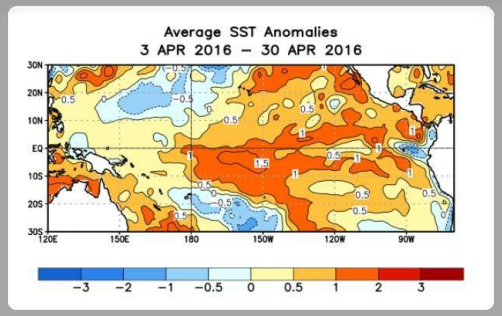
8,635 miles

Approximate distance between NCWCP and WSO Koror (Palau)

CPC – – Pacific Islands

SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

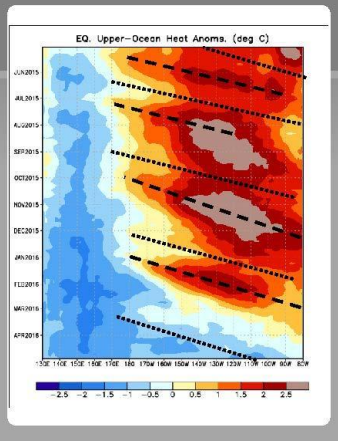
During the last four weeks, equatorial SSTs were above average across the Pacific, except near S. America.



Weekly Heat Content Evolution in the Equatorial Pacific

Downwelling phases of a Kelvin wave were observed in mid-May to late June, July-August, and October to November, and January-February 2016.

Since February 2016, an upwelling phase of a Kelvin wave has influenced the equatorial Pacific.



Oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.

CPC – – Pacific Islands

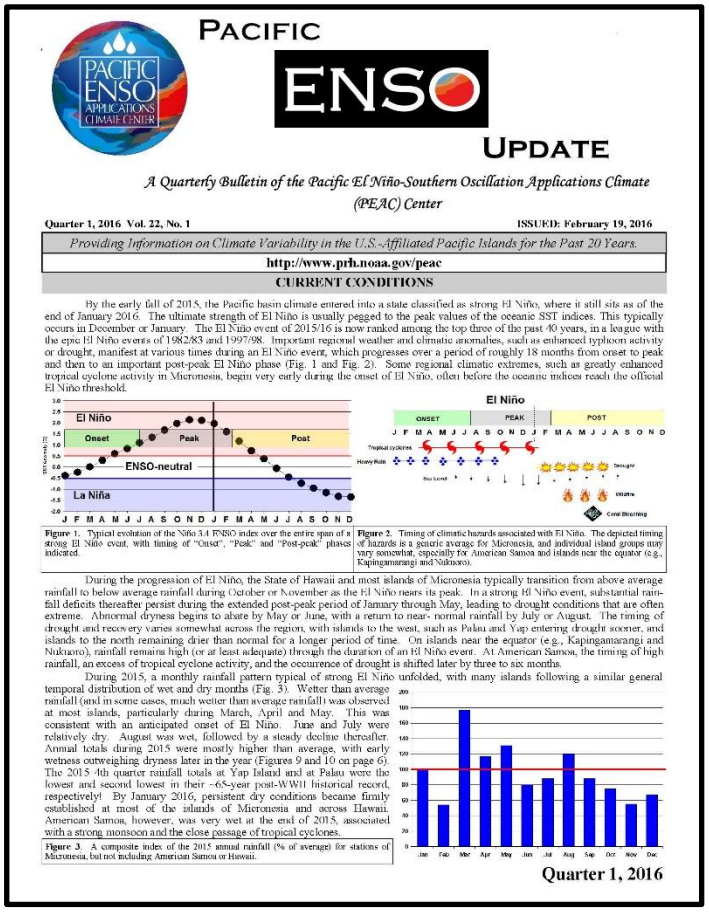
- Establised in 1994 as a multi-institutional partnership to conduct research and produce information products on climate variability as it impacts US Affiliated Pacific Islands
- Strong relationships between NOAA , the University of Guam, and the University of Hawaii

NOAA UOG/WERI UH/SOEST

CPC – – Pacific Islands

- Fall of 2014 – In response to increasing signs of a strong El Niño, PEAC and NOAA Pacific Region formed the El Niño Tiger Team to start outreach and awareness effort.
- First briefing held in August 2014 in the Inouye Regional Center for NOAA Pacific Region and DoD Pacific Command (PACOM) staff
- 5 subsequent briefings held, most recently May 9, 2016.

CPC – – Pacific Islands



PACIFIC ENSO UPDATE

A Quarterly Bulletin of the Pacific El Niño-Southern Oscillation Applications Climate (PEAC) Center

Quarter 1, 2016 Vol. 22, No. 1 ISSUED: February 19, 2016

Providing Information on Climate Variability in the U.S.-Affiliated Pacific Islands for the Past 20 Years.

http://www.prh.noaa.gov/peac

CURRENT CONDITIONS

By the early fall of 2015, the Pacific basin climate entered into a state classified as strong El Niño, where it still sits as of the end of January 2016. The ultimate strength of El Niño is usually pegged to the peak values of the oceanic SST indices. This typically occurs in December or January. The El Niño event of 2015/16 is now ranked among the top three of the past 40 years, in a league with the epic El Niño events of 1982/83 and 1997/98. Important regional weather and climatic anomalies, such as enhanced typhoon activity or drought, manifest at various times during an El Niño event, which progresses over a period of roughly 18 months from onset to peak and then to an important post-peak El Niño phase (Fig. 1 and Fig. 2). Some regional climatic extremes, such as greatly enhanced tropical cyclone activity in Micronesia, begin very early during the onset of El Niño, often before the oceanic indices reach the official El Niño threshold.

Figure 1. Typical evolution of the Niño 3.4 ENSO index over the entire span of a strong El Niño event, with timing of "Onset", "Peak" and "Post-peak" phases indicated.

Figure 2. Timing of climatic hazards associated with El Niño. The depicted timing of hazards is a generic average for Micronesia, and individual island groups may vary somewhat, especially for American Samoa and islands near the equator (e.g., Kapingamarangi and Nikunoro).

During the progression of El Niño, the State of Hawaii and most islands of Micronesia typically transition from above average rainfall to below average rainfall during October or November as the El Niño nears its peak. In a strong El Niño event, substantial rainfall deficits thereafter persist during the extended post-peak period of January through May, leading to drought conditions that are often extreme. Abnormal dryness begins to abate by May or June, with a return to near- normal rainfall by July or August. The timing of drought and recovery varies somewhat across the region, with islands to the west, such as Palau and Yap entering drought sooner, and islands to the north remaining drier than normal for a longer period of time. On islands near the equator (e.g., Kapingamarangi and Nukunoro), rainfall remains high (or at least adequate) through the duration of an El Niño event. At American Samoa, the timing of high rainfall, an excess of tropical cyclone activity, and the occurrence of drought is shifted later by three to six months.

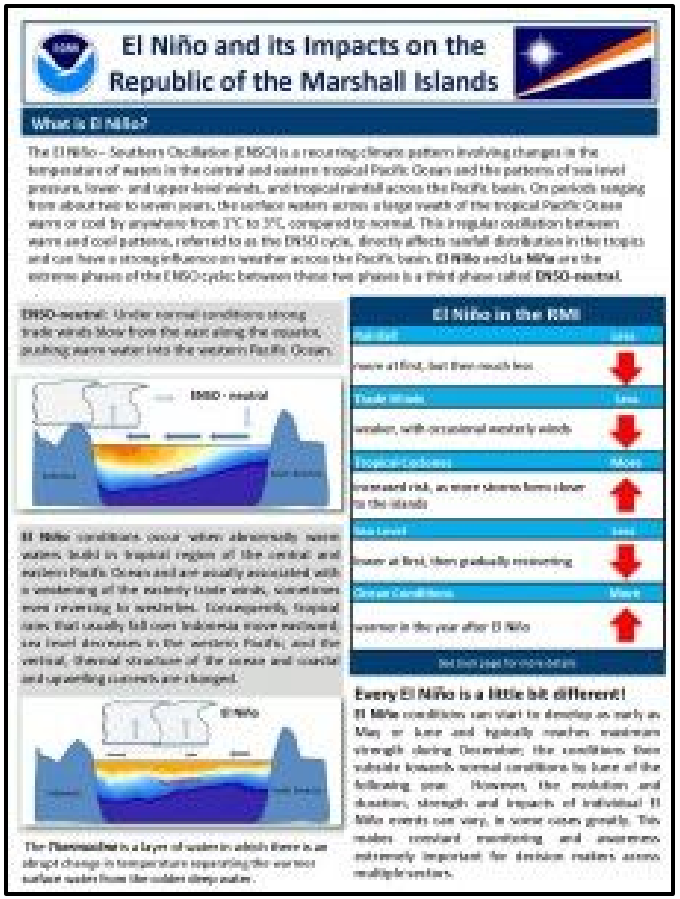
During 2015, a monthly rainfall pattern typical of strong El Niño unfolded, with many islands following a similar general temporal distribution of wet and dry months (Fig. 3). Wetter than average rainfall (and in some cases, much wetter than average rainfall) was observed at most islands, particularly during March, April and May. This was consistent with an anticipated onset of El Niño. June and July were relatively dry. August was wet, followed by a steady decline thereafter. Annual totals during 2015 were mostly higher than average, with early wetness outweighing dryness later in the year (Figures 9 and 10 on page 6). The 2015 4th quarter rainfall totals at Yap Island and at Palau were the lowest and second lowest in their ~65-year post-WWII historical record, respectively! By January 2016, persistent dry conditions became firmly established at most of the islands of Micronesia and across Hawaii. American Samoa, however, was very wet at the end of 2015, associated with a strong monsoon and the close passage of tropical cyclones.

Figure 3. A composite index of the 2015 annual rainfall (% of average) for stations of Micronesia, but not including American Samoa or Hawaii.

Quarter 1, 2016

- **Summary of current conditions**
  - Rainfall
  - Tropical cyclone activity
  - Sea-level
  - Southern Oscillation Index
  - Sea surface temps
- **Local and downscaled outlooks**
  - Rainfall
  - Sea-level anomalies
- **Anticipated Impacts**

CPC – – Pacific Islands


El Niño and its Impacts on the Republic of the Marshall Islands

What is El Niño?

The El Niño – Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean and the patterns of sea level pressure, lower- and upper-level winds, and tropical rainfall across the Pacific basin. On periods ranging from about two to seven years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This irregular oscillation between warm and cool patterns, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the Pacific basin. **El Niño** and **La Niña** are the extreme phases of the ENSO cycle; between these two phases is a third phase called **ENSO-neutral**.

ENSO-neutral: Under normal conditions strong trade winds blow from the east along the equator, pushing warm water into the western Pacific Ocean.

ENSO - neutral

El Niño conditions occur when abnormally warm waters build in tropical region of the central and eastern Pacific Ocean and are usually associated with a weakening of the easterly trade winds, sometimes even reversing to westerlies. Consequently, tropical rains that usually fall over Indonesia move eastward, sea level decreases in the western Pacific, and the vertical, thermal structure of the ocean and coastal and upwelling currents are changed.

El Niño

The **Thermocline** is a layer of water in which there is an abrupt change in temperature separating the warmer surface waters from the colder deep water.

El Niño in the RMI

Rainfall	Less
Trade Winds	Less
Tropical Cyclones	More
Sea Level	Less
Ocean Conditions	Warm

Every El Niño is a little bit different!

El Niño conditions can start to develop as early as May or June and typically reaches maximum strength during December; the conditions then subside towards normal conditions by June of the following year. However, the evolution and duration, strength and impacts of individual El Niño events can vary, in some cases greatly. This makes constant monitoring and awareness extremely important for decision makers across multiple sectors.

- **Developed plain language "One-Pagers" for 7 island groups**
  - What is El Niño
  - Specific Impacts
  - Preparedness
- **Wide distribution**
  - Utilized strength and reach of NOAA Pacific Islands Regional Collaboration team

CPC – – Pacific Islands

- **PEAC, NWS Pacific Region, and WFO Guam staff conducted workshops to increase awareness**
  - Hawaii, Guam, Saipan,
  - Republic of Palau
  - Federated States of Micronesia
  - Republic of the Marshall Islands
  - American Samoa
- **Local NWS offices carried the message to the last mile**

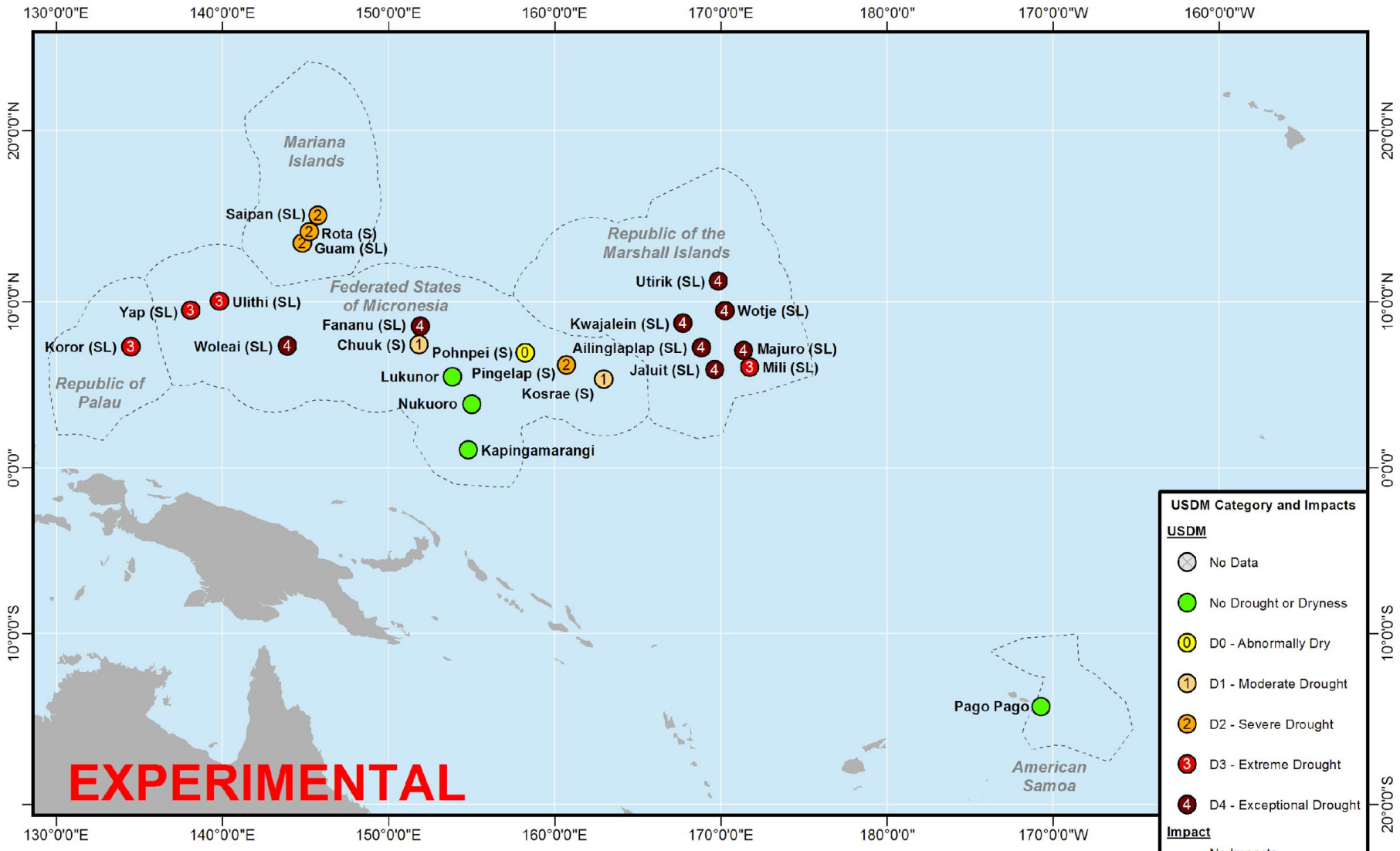
Typhoon Soudelor

- August 2, 2015: Typhoon Soudelor makes a direct pass over the island of Saipan as a category 3 typhoon. Max winds are estimated at 110 G 130 knots at landfall. Damage assessment suggests possibility of terrain induced winds in excess of 150 knots.
- Despite island wide devastation, island-wide power outage, and significant loss of houses and structures, residents took necessary precautions, took appropriate shelter, and there were *no lives lost*

U.S. Drought Monitor

U.S. Affiliated Pacific Islands

May 3, 2016



Author: Richard Heim, NOAA/NCEI

So the next time you look at an SST chart…

Zoom in and see the Countries

Zoom in and see the Islands

Zoom in and see the offices

Zoom in and see the people

Zoom in and see the Last Mile…

Photo courtesy Charlene Felkley